AUTOMATIC DATA PROCESSING: A NEW TOOL FOR NAVY MANAGEMENT

by

Joseph P. Vinti
Bachelor of Science
Rider College, 1954

A Thesis Submitted to the School of Government, Business and International Affairs of The George Washington University in Partial Fulfillment of the Requirements for the Degree of Master of Arts in Business

April 26, 1965

Thesis directed by

Karl Ernest Stromsem, Ph. D.

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PREFACE

Automatic data processing equipment today plays an ever increasing role in the effective management of government operations. Interest in this area of management is shown at every level, from the lowest level of actual users of computers, up to and including the President of the United States. The following letter, which accompanied a special report, shows this interest.

March 2, 1965

The Honorable the President of the Senate
The Honorable the Speaker of the House
of Representatives

Sirs:

The use of automatic data processing equipment during the past ten years has contributed significantly to increased effectiveness and rising productivity in governmental operations. The electronic computer has enabled the Government to carry out programs which otherwise would have been impossible. Better and more economical services to the public have been achieved through the use of this equipment.

Government policies with respect to the acquisition and use of automatic data processing equipment have been a matter of interest to a number of congressional committees. In 1963, in response to a congressional request, President Kennedy directed the Bureau of the Budget to undertake a comprehensive review of this subject and to prepare a report to the Congress. This study is now complete. The suggestions for improvement outlined in the enclosed report have my approval.

I have requested the Director of the Bureau of the Budget to work with the interested committees of the Congress and with the executive agencies concerned to assure the most economical and effective use of this highly important area of management.

The Bureau of the Budget at an early date will set forth, in a Circular, specific Government-wide responsibilities of the Bureau of the Budget, General Services Administration, Department of Commerce, and Civil Service Commission, to carry out the recommendations contained in the report.

Sincerely,

The above letter is signed Lyndon B. Johnson.[1]

In 1963 a report was issued by a House Subcommittee investigating uses of electronic data processing equipment in the Federal government. One of the conclusions of that report was:

> Machine technology has progressed beyond the ability of people to use it. The technological gap should be closed by giving increased recognition to the people in EDP systems, by increased attention of top management to EDP matters, and by acceleration of automatic programing development.[2]

A recommendation of the committee based on the above conclusion was: "Consideration might be given to a management sciences academy as recommended by the Department of the Navy."[3] It was the reading of the Congressional report which prompted the subject of this paper.

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[1]This letter accompanies a report prepared by the Bureau of the Budget entitled Report to the President on the Management of Automatic Data Processing in the Federal Government. The report is dated February, 1965.

[2]U. S. Congress, House, Committee on Post Office and Civil Service, Use of Electronic Data Processing Equipment in the Federal Government, 88th Cong., 1st Sess., 1963, p. 5.

[3]Ibid.

A research study into Navy views concerning the Navy ADP program, and what, if anything, came from the suggestion of a "Management Sciences Academy," would be both interesting and provide the answer to the question--Is the Naval Service keeping pace with the field of ADP and its implications for management?

In answering the above question, answers to the following inquiries should also be apparent. Does the Naval Service have a formal ADP program? What problems exist today within the Naval Service because of ADP that concern management? What are the Navy goals, both short range and long range, as regards management's use of ADP equipment? What is being done to train management in the Naval Service to fully utilize data processing equipment? What are some of the implications for the future because of ADP?

This paper investigates the above questions and concludes that Naval management functions, concepts and techniques are undergoing change, and will change more in the years to come because of automatic data processing; and training is presently being conducted to prepare Navy management for the era, which will see greater use yet of machine technology.

The following approach to the subject matter will be used in the presentation: Chapter I presents the history, scope and control organization of the official Navy ADP program. Chapter II points out the objectives of the program. The objectives are categorized as to short range, long range, and overall objectives

as they relate to management. Chapter III presents the plan whereby the Navy expects to achieve the objectives mentioned in Chapter II. The plan is given in terms of time stages of accomplishments. Chapter III also discusses some areas of application of ADP uses, and gives some indications as to what can be expected in the future. The presentation concludes with Chapter IV, which summarizes and draws conclusions from the material as presented.

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HISTORY, SCOPE AND ORGANIZATION OF THE NAVY ADP PROGRAM

In the space of time, the growth of the Navy Automatic Data Processing Systems has been relatively short. It was during World War II that military demands required a means whereby extensive and complex mathematical problems could be solved, which led to the first electro-mechanical and electronic digital computers designed for high speed resolution of mathematical formulas. Within the Navy, central coordination or control procedures relative to acquisition and use of electronic computers have existed in one form or another since 1946.

During its developmental stages the emerging technology of data processing has had science as its principal focus. The reasons for this emphasis are attributable to the exponential growth of scientific research and development. In describing the growth of science, Dr. Derek Price points out that although our population is doubling every thirty to fifty years, science in America is doubling every ten years.[1] This fantastic growth in

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[1]Derek Price, Science Since Babylon (New Haven: Yale University Press, 1961), p. 119.

science has allowed the use of machines to evolve to other than the purely scientific areas, and coming to the forefront is the application of machine technology to management's household. Within the Navy this development followed a very traceable pattern.

To coordinate the development of the Navy's scientific computer facilities, a Mathematical Computer Advisory Panel (MCAP) was established by the Office of Naval Research in 1946. In 1952 the charter of the panel was expanded to include a review of equipment selection and justification documentation. In 1955 the MCAP was supplanted by a Punched Card and Electronic Computer Advisory Committee.

It was about that time that the use of computers in the administrative field became significant. It was also in 1955 that strong congressional interest and critical General Accounting Office surveys of punched card operations in the military departments led the Secretary of the Navy to establish a control at his level by delegating authority and responsibility for Electronic Assorting Machines to the Administrative Assistant to the Secretary of the Navy. This authority and responsibility was extended in 1955 to include sorting machines and computers when applied to business administration, logistics, and record keeping operations. (An interesting side note at this point is the magnitude of just the last item mentioned, "record keeping".) Although the Navy would be only a percentage of the total, even a small percentage of the

following figures can be considered a gigantic operation:

> The Federal Government spends over $4 billion per year on its production of over 25 billion pieces of paper, and is storing records which would easily fill eight Pentagons.[1]

For assistance, the Administrative Assistant to the Secretary of the Navy assigned staff responsibility for ADP to the newly formed Navy Management Office, and established the Data Processing Advisory Committee. The membership of this committee was comprised of individuals from all bureaus and principal offices of the Navy Department. The Data Processing Advisory Committee supplanted the Punched Card and Electronic Computer Advisory Committee until 1958, when in response to strong Presidential action to reduce committees, it was abolished. The authority and responsibility of the Administrative Assistant was extended in 1961 to include ADP equipment used for engineering-scientific applications, and in 1963 to include ADP equipment used in intelligence systems.

With the exception of equipment used for the control of weapons systems and equipments located at contractors' plants, the control procedures for the use of ADP equipment within the Navy, as evolved throughout the course of the above mentioned developments, are codified and promulgated by Secretary of the Navy

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[1]C. P. Bourne, Methods of Information Handling (New York: John Wiley and Sons, Inc., 1963), p. 1.

Instruction P10462.7 of April 16, 1959.[1] The title of this document is "Data Processing in Navy Management Information Systems."

Scope

The scope of the Navy ADP program over the years has grown to tremendous proportions. Tremendous in the sense of numbers and applications in the short span of fifteen years. If it is true, as has been expressed in many quarters, that the age of data processing is still in its infancy, where the next score of years will take us is almost unimaginable at present.

Illustration 1, following, reveals that in 1950 only two computers were in use in the Federal Government. By the end of Fiscal Year 1964, it will be noted that the number of computers in use had risen to 1767. Projections indicate a continuing increase in use through 1966. By the end of 1966 Bureau of the Budget estimates place the number of computers in use in the Federal Government at 2150. This is a rather phenomenal growth, and the total cost for ADP in 1964 was $1,106,000,000.

For Fiscal Year 1964 the Navy's share amounted to 16% of the total cost of ADP utilized in the Department of Defense. The

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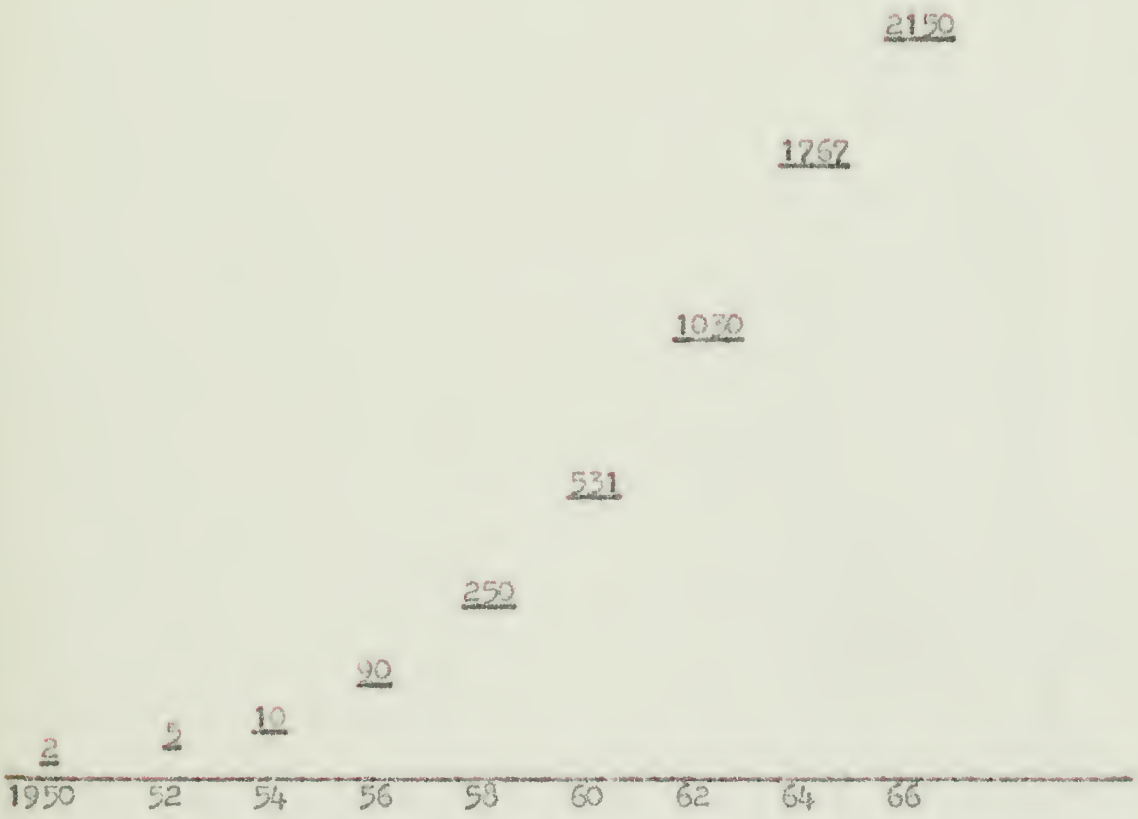
[1]U. S. Congress, House, Hearing before the Subcommittee on Census and Government Statistics of the Committee on Post Office and Civil Service, Use of Electronic Data Processing Equipment, Part 1--Comptroller General and Department of Defense, 88th Cong., 1st Sess., 1963, p. 115.

Figure 1

GROWTH IN NUMBER OF COMPUTERS IN THE FEDERAL GOVERNMENT



Source: Figures taken from Chart 6, 1964 Inventory of ADP in the Federal Government, GPO, 1964

1963-- Actual Figures
1964 & 1965-- Agencies' estimates
1966-- Bureau of the Budget estimates

Defense Department accounted for 67% of the total Federal expenditure. The following is a breakdown of ADP cost for Fiscal Year 1964 within the Department of Defense.[1]

Agency	Millions	Percent
OSD	54	4.9
Army	216	19.7
Air Force	285	25.8
Navy	184	16.6
Total for Defense Department	739	67.0

This growth within the Naval Establishment, depicted by Illustrations 2 and 3, and Tables 1-3 following, is briefly summarized as follows for fiscal year 1964:[2]

Illustration 2 shows that in 1964 the Navy had 139 punched card installations and 253 computer installations for a total of 392 machine installations. This compares with a total of 210 just four years prior.

Illustration 3 shows that the dollar rental of Automatic Data Processing Equipment (ADPE) has grown from $25,046.4 million in Fiscal Year 1960 to more than $41 million in Fiscal Year 1964.

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[1]U. S. Congress, Subcommittee of Census and Government Statistics of the Committee on Post Office and Civil Service, 1964 Inventory of Automatic Data Processing (ADP) Equipment in the Federal Government, 88th Cong., 2d Sess., 1964.

[2]Use of Electronic Data Processing Equipment, Part 1--Comptroller . . . , op. cit., pp. 142-146.

Figure 2

NUMBER OF COMPUTERS & EAM INSTALLATIONS

** EAM (Punched cards)
Computers

Source: Use of Electronic Data Processing Equipment, Part 1- Comptroller, op. cit., p. 143.

Figure 3

DOLLAR RENTAL OF ADPE BY FISCAL YEAR
(in millions)

Fiscal Year	60	61	62	63	64
EAM	3,034.3	2,995.2	5,810.0	5,630.0	4,768.0
EDPE and AFFIL. EAM	25,046.4	28,078.2	30,106.0	35,754.0	41,424.0
No. EDPE	100	129	194	213	253

Source: Use of Electronic Data Processing Equipment, Part 1- Comptroller, Op. cit., p. 144.

TABLE 1

TOTAL NAVY ADP COST
(in thousands of dollars)

Fiscal year - 61	$ 82,586.4
Fiscal year - 62	84,724.4
Fiscal year - 63	95,088.8
Fiscal year - 64	102,973.0

TABLE 2

NAVY ADP PERSONNEL STRENGTH

Fiscal year - 61	8,826
Fiscal year - 62	9,269
Fiscal year - 63	9,398
Fiscal year - 64	9,575

Source: Use of Electronic Data Processing Equipment, Part 1- Comptroller, op. cit., pp. 142, 145.

TABLE 3

COMPUTERS AND RENTAL BY MANUFACTURER

Manufacturer		Number of computers		
	Rented	Purchased	Total
IBM	$22,003.0	129	7	136
Remington Rand	2,641.0	11	3	14
National Cash Register	1,221.0	10	0	10
Advance Scientific Inst	36.0	1	0	1
Bendix	85.0	4	8	12
Royal	52.0	3	2	5
RCA	971.7	8	0	8
Honeywell	245.0	2	0	2
Controlled Data Corp	559.0	2	3	5
Monroe	6.3	1	0	1
Burroughs	915.0	5	5	10
Philco	517.0	1	1	2
Packard-Bell	-	-	2	2
ALWAC	-	-	5	5
Total	$29,250.0	177	36	213

Note- Above rental does not include "affiliated" EAM equipment.

Source: Use of Electronic Data Processing Equipment, Part 1- Comptroller, p. 146.

Table 1 and Table 2 show the total cost and breakdown over the same period of operating the Navy's ADP program, and the numbers of personnel engaged within the ADP program.

Table 3 points out that as of 1964 fourteen different manufacturers of computers were represented in the Navy inventory of data processing equipment.

The following tabulation shows the current location of computer units by bureau, office, and command.[1]

BuWeps	135	Exec. Off. Sec.	1
BuS&A	58	CIC, Pac Flt.	1
BuShips	48	Comptroller	10
BuPers	20	Naval Ops.(D.C.).	12
BuYards and Docks	9	Naval Operations.	21
BuMed & Surgery	2	Naval Research.	21
		Marine Corps	33

Organization

Authority to act for the Secretary of the Navy in matters related to the management and control of punched card and automatic data processing systems and equipment used in business administration, logistics, and engineering-scientific operations

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[1]R. W. Legare, et al., "ADP Applications Currently in Effect in the Department of the Navy," unpublished term paper, The George Washington University, Washington, D. C., 1964, p. 8.

[illegible]

of the Department of the Navy, was delegated to the Administrative Assistant to the Secretary of the Navy. He was authorized to determine policy, issue directives, establish procedures, require reports from bureaus and offices, and take such actions as were necessary. The Administrative Assistant was designated as the senior policy official to monitor and review the development and maintenance of data processing support programs within the Department of the Navy, and to monitor the presentation of such programs to the Assistant Secretary of Defense (Installations and Logistics) as required by Department of Defense directives.[1]

The staff support for the Administrative Assistant was furnished by the Navy Management Office. The Chief, Navy Management Office was assigned this staff support function. He furnished the assistance necessary to the Administrative Assistant to develop, coordinate, and evaluate plans and policy recommendations, prepare directives, disseminate information, provide technical advice, review and evaluate progress, analyze reports, and perform such other functions as were necessary and appropriate to attain the program objectives. The Navy Management Office collaborated with, advised, and assisted the bureaus and offices of the Navy Department in these bureaus and offices discharging their responsibilities under the ADP program. Working through the Office of the Chief of Naval Operations, the Headquarters, U. S. Marine Corps, and the

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[1]Use of Electronic Data Processing Equipment, Part I---Controller. . . , op. cit., p. 116.

bureaus and offices, Navy Department, the Navy Management Office provided this staff assistance as necessary for the following:[1] (1) coordination of requirements for orientation, training, and staffing criteria; (2) maintenance and dissemination of information on equipment, applications, and methods and techniques; (3) control of the procurement, transfer, and the release of punched card and electronic data processing equipment, and auxiliary equipment, throughout the Department of the Navy, and maintenance of complete inventory and utilization statistics of such equipment; and (4) consolidation, cross servicing, establishment, and disestablishment of punched card and electronic data processing installations to achieve more effective utilization and management.

Also part of the ADP program are the Chief of Naval Operations, the Commandant of the Marine Corps, and the chiefs of each bureau and office. These individuals, as part of their command or management responsibilities perform the following:[2] (a) actively promote the objectives of this program; (b) establish and maintain appropriate ways and means for their organizations under his management control; (c) provide guidance, orientation, familiarization, and technical training of personnel under his command or management responsibility; (d) provide the Administrative Assistant to the Secretary of the Navy with information and assistance; and (e) report progress of data processing programs within his command and/or management responsibilities in his annual

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[1] Ibid. [2] Ibid.

[1] 1920-

report to the Secretary of the Navy.

In 1964, organizational changes took place within the framework as described above. The Navy Management Office described has been changed to the Office of Management Information (OMI), but it still provides the staff assistance required in ADP matters. Whereas the Administrative Assistant to the Secretary of the Navy was the senior policy official in ADP matters, as late as March 22, 1965, a change to existing instructions concerning ADP matters within the Department of the Navy states: "Wherever it appears, and in lieu of 'Administrative Assistant to the Secretary of the Navy,' substitute 'Navy ADP Policy Official.'"[1]

Another portion of this change transmittal states the following, which is a good broad concept of the control organization as it exists at the present time.

> IV. GENERAL POLICIES
>
> A. The Department of the Navy ADPE Program is predicated upon the principle that its administration is essentially a line responsibility which is vested in the departmental operating executives who, for the purpose of this Instruction, are to be construed as being: the Chief of Naval Operations (CNO), Commandant of the Marine Corps (CMC), Chief of Naval Material (CNM), Deputy Comptroller of the Navy (DCN), Chief of Naval Research (CNR), Chief of Naval Personnel (CNP), and the Chief of the Bureau of Medicine and Surgery (CBMS). In fulfilling this responsibility these officials will be guided and governed by the policies and procedures promulgated by the Department of the

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[1]Secretary of the Navy Instruction P10462.7A Change Transmittal 1, 22 March 1965, Washington, D. C., (cover sheet).

Navy ADP Policy Official. The latter will, in turn, be afforded complete staff support by the Office of Management Information (OMI).[1]

Summary

A formal program for the use of ADP equipment exists within the Navy Department. The history of the program is not yet a score of years old. The growth of the program over the years has been rapid as shown by the illustrations and tables presented in this chapter, and an organizational system is in being for the control of the program, with definite responsibilities being given to various segments of the Department of the Navy.

The following chapter will show what the objectives of the program are concerning management within the Naval Establishment.

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[1] Ibid., p. IV-1.

CHAPTER II

OBJECTIVES OF THE PROGRAM CONCERNING MANAGEMENT

Close to 300 computers and affiliated punched card equipment, over $100 million in annual expenditures, and some 9.5 thousand personnel form the parameters of the Navy ADP program. What does the Naval service expect in return for this total outlay? This chapter will explain how this effort is expected to pay a return.

The basic objective of the Navy data processing program is the systematic evolution of automatic data processing and associated equipment and techniques to best contribute to general management improvement. The ultimate objective is an optimal informational service to Navy and Marine Corps management of resources.[1] Improvement can be thought of as more informed decision making. There are available today, as will be in the years to come, the tools which will make the decision, not better per se, but rather more systematic, reliable, and easier to come by. The tools come in the guise of ADP equipment.

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[1]J. N. Dillon, "Data Processing in Navy Management Information Systems," Secretary of the Navy Instruction P10462.7, Washington, D. C., 1959, p. II-1.

The electronic data processing equipment that is available on the market today is capable of meeting almost every requirement for gathering, processing, recording, communicating, and reporting data of all types. Processing speeds are supersonic, storage capacity is theoretically unlimited, input and output capabilities challenge the ability of the system's engineer to utilize them effectively.[1]

If a decision is a choice among alternatives (if there is only one way to go, no decision is necessary to proceed), then the prime objective of the Navy program is to utilize the information made available through ADP and select the most correct of several alternatives to any given problem. The decision process not only includes the alternative consequence of doing a certain act in different ways, but includes the consequence of not doing the act. It is not possible to know all the consequences of not doing or doing a given act, but the major consequences should be considered.[2]

With these ideas behind the basic objective, it follows that local direct economy is not the primary benefit hoped to be achieved in the Navy program, but tather an improvement to total management effectiveness. Within the Naval establishment, by far the best test of this increase in management effectiveness is the

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[1]J. L. Woodbury and W. M. Cavitt, "Problems for the EDP Manager," unpublished term paper, The George Washington University, Washington, D. C., 1964, p. 1.

[2]Henry H. Albers, Organized Executive Action: Decision Making, Communication, and Leadership (New York: John Wiley and Sons, 1962), pp. 20, 203.

effectiveness of the operating forces. It is these forces which necessitate the very being of any other organization of the Department of the Navy.

The program as envisioned has both short and long range goals. The short range aspects represent those objectives which should be clearly reflected in all current data processing endeavors or proposals. The long range goals represent those characteristics which should become generally evident in ADP applications in the foreseeable future. A definite purpose of all current actions should be an attainment of these long range goals.

As short range objectives, it is intended to:

1. Have installed and operating productively, at the earliest practical date, automatic data processing equipment at every activity of the Navy and Marine Corps, where it is of military or economic advantage to do so, in accordance with established procedures and criteria.

2. Create an awareness among managers of the potential that exists for providing the kind of information that is required to manage effectively, and the consequent necessity for these persons to determine and make known those elements of information which they consider essential to the performance of their management functions. (This is discussed at greater length under long range objectives when referring to integration of information systems.)

3. To establish the means for overall Navy planning and coordination of developments in automatic data processing, associated equipment and techniques, including source data automation and communications.

4. To insure adequate research and development of information systems equipment and techniques for unique Navy management requirements. This involves the inclusion within the installations of "pilot installations" for that purpose, as well as research work otherwise conducted or sponsored by the Navy. In all cases, an objective is to avoid gaps and overlaps in necessary research and development efforts.

5. To bring about an orderly development of standardization of equipments, storage and transference media, coding systems, identification and classification systems and symbols, and various requirements for compatibility. This will preclude unduly prolonged or excessive conversions, translations, and adaptations; but, with due regard to the state of the arts involved, avoiding inhibition of needed developments by premature standardization.

6. To minimize the cost of initial stages of evolution of advanced information systems equipment and techniques. This includes joint use or time sharing of information systems equipment, but not to the extent of destroying the utility to users that justifies the equipment. It also includes minimum duplication of feasibility study, applications development and test, and equipment selection.

7. During initial stages of ADP evolution, to make special efforts (including temporary detailed cost accounting and special surveys and analyses) to develop, as validly as practicable, measures of the influence of ADP on Navy effectiveness, economy, and efficiency.

8. To take positive steps to anticipate the need for and to make alterations in technical and procedural manuals to ensure that none of the content thereof, by commission or omission, represents an unnecessary obstacle to the earliest best use of modern information systems equipment.[1]

Realizing that the entire process of adjusting to ADP processes is evolutionary rather than revolutionary, the official Navy program sets some long range goals as well as the short range objectives previously described. The management problem, which in turn generates the information system requirements, is vast in its very nature due to the mission, magnitude, and complexity of the Navy and Marine Corps. The most advanced knowledge to date in all fields of science, leads to a clear indication that there will be two predominant characteristics of information systems equipment and technique if Navy and Marine Corps requirements are to be met satisfactorily. It will involve ultimate full exploitation of (1) the time and space properties of electronic, magnetic, light, chemical, and electro-mechanical devices, and (2) advanced rationale or techniques for better predictions,

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[1]Dillon, op. cit., p. II-5.

combinations, sequences and understanding, i.e., management sciences, for more scientific management. However, a constant objective, for all times, is the properly constituted and understood combination of at least two of the ingredients of Navy management; the information system (a supporting service), and the motivations, restraints, and judgment of management itself (a direct line responsibility).[1]

There are five long range goals to the Navy program: (1) complete integration (which further breaks down into four categories); (2) information selectivity; (3) maximum use of management by exception; (4) maximum use of management sciences; and (5) finding the economic balance between allocation of resources to information systems, and allocation of resources to all other Navy purposes.[2]

Complete Integration

Complete integration calls for the integration of the following elements: (1) organization, (2) management function, (3) resources, and (4) languages.

1. Organization integration refers to an integrated communications system within and between organizations. It is an interconnection of all data sources, processing units and users;

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[1] Ibid., pp. II-9-II-11.

[2] Ibid.

[1] Ibid., p. [illegible].

[2] Ibid.

thereby, to become the equivalent of one whole "Navy memory." Its concept is that there would be one input for a piece of data, and a maximum access for anybody with a need to know to interrogate any part or all of it. The purpose of this would be not only to increase the effective time of all resources, but also, to reduce the total quantity of information required. Proper consistency of communications equipment, language, timing, and media is a consequent part of this objective. This goal does not have as its objective either a centralization or decentralization of management, but rather a communication system which will accommodate either one equally well.

2. Management function integration refers to a constant comparison at each level of organization between that which "is," and that which "should be" or "can be" within each level of management cognizance. It is an integration of related data created in the various steps of the management cycle. Such steps as plans and programs, direction, and evaluation must of necessity produce "feedback" as a basis for control. A good definition of feedback is: "recording, processing, and transmitting information concerning operations in a manner and in time so managers can control the operation."[1] Both planning and performance data must be in the same language or else no comparison can be meaningful. Another interesting aspect of this feedback principle is presented

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[1]G. Kozmetsky and P. Kircher, Electronic Computers and Management Control (New York: McGraw-Hill Book Co., 1965), p. 159.

by Professor Joseph L. Massie, at the University of Kentudky, when he states:

> . . . the feedback concept, which is so vital to information theory and mechanical controls, can, with modifications, also be of value in improving techniques of human direction and control in an organization.[1]

The statement seems to indicate that once managers fully understand the principles and workings of this feedback in their machine systems, there will undoubtedly be an analogous application to communications between managers of an organization, each providing what is needed by the other.

3. Resources integration has as its objective to include in each bit or item of data input, and keep together in subsequent summaries of it, all of the significantly interrelated resource elements. Any planned or actual occurrence almost always involves interdependent successive states and changes of resource elements, such as personnel, material, tools, facilities, time, that which was to be done, that which was done, and the dollar and cents values represented by each of these elements. This concept has as its logical base the approach that when planning and programing for all elements (e.g., aircraft, personnel, ships, bases, funds, etc.) can be done together (integrated), the higher the probability

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[1]J. L. Massie, "Automatic Horizontal Communications in Management," Current Issues and Emerging Concepts in Management, ed. Paul M. Dauten, Jr., (Boston: Houghton Mifflin Co., 1962), p. 111.

that the final actuality of all will be in optimum balance with each other; and this principle applies to every level and activity.

4. Language integration refers to the ability of the coding of information, so that the information recorded by one machine may be read and interpreted correctly by other machines without intermediate code conversion steps or processing. This means that information will be able to be recorded, transferred, processed, summarized, analyzed, stored, recalled, displayed, or otherwise made useful and available, with a minimum of human intervention as data go through their full life from their creation to the end of their utility.

Information Selectivity

This objective refers to the screening of data (automatically) out of the full store of that which are available, and again automatically delivering just those data which are necessary to each particular unit and level. It also involves seeing to it that each management unit has the capability to "interrogate" the full store of data and get an immediate response. As one can logically see, if it were not for this capability in both directions, to insure that each unit received what it needed would require a publication of all available data distributed to everybody. A consequent objective of this information selectivity would be a very high degree of flexibility in data processing equipment and techniques in order to change the programmed output easily and quickly.

Maximum Use of Management by Exception

The objective here is to relegate to machines all mechanical decisions, leaving for human considerations only those things requiring mental facilities no machine has yet been constructed to duplicate. Such things as association of ideas, imagination, judgment, ethics and the like, to mention a few. A mechanical decision is one that can be predetermined by establishing a fixed complete logic of "ifs," "ands," and "ors," the combination of which determine the particular decision automatically to be made, including the "mechanical decision" to refer items to human judgment, under predetermined conditions. What we approach is automation of management itself--utilizing the optimal combination of machines and human minds to do things which, respectively, are mechanical and exclusively human in nature. The end result of using machines for all mechanical work that people would otherwise do produces a more accurate, more consistent, and generally better work product; and more time for management personnel to devote to exceptions, creative thinking, basic planning and self-improvement.

Although this concept of management by exception seems to do a great deal in cutting down the detail brought to the attention of managers, a new difficulty has arisen, namely:

> In his attempt to get the operation back to standard, too often the manager overcompensates or undercompensates for the variation, /recall the explanation of referring to humans those mechanical decisions that human ability is required/ . . . . The problem not only is to report that an operation is out of line, but to show the relative degree to which it is out of line, together with an indication

> of the amount of corrective action, which should be taken. At present this corrective action usually is decided upon by the manager largely on the basis of his accumulated personal experience. As more is learned about the factors which throw operations out of line, these corrections can be incorporated into feedback systems so that they will become more and more automatic.[1]

Knowledge of these factors surprisingly enough will probably come from processed data, so in effect, one finds humans in the middle of a continuous loop of information services.

Maximum Use of Management Sciences

In its views concerning management sciences, the Navy's objective is a full appropriate use of the most scientific techniques, and equipment for computation and sequences in the use of resources for any given result desired. Where the object of one aspect of management by exception is to free the human mind from mechanical use, the object in this case is to add an extension to the human mind, allowing it to utilize the latest services available for final judgment or selection of management decision alternatives.

This service adds materially to the "reasoning" powers of the human mind, enabling it to develop intelligence which is beyond the capacity of the mind itself to produce within an acceptable time, applying older standards or methods. Only a

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[1]Kozmetsky and Kircher, op. cit., p. 164.

fraction of the potential of the human mind is now used. A desired effect is less uncertainty, hence, not only better but quicker action. It would follow, therefore, that the better the plans, programs and predictions, the less need for subsequent readjustment.

A consequent objective is the development and use of scientists and such scientific techniques as statistical sampling, stochastic process, decision tree, linear programming, operations research, correlation analysis, simulation, program evaluation review technique, and others, many yet to be developed.

The use of scientific methods in management applications is nothing new, for as early as the 1890's Frederick W. Taylor applied scientific methods to certain business operations. Some of these scientific methods have been employed in the past by managers, but the difference lies in the fact that now the ability exists to perform some of the management planning and control functions in an organized and systematic fashion, which up to now have been carried on piecemeal.

ADP equipment and the use of management sciences (decision techniques) make this all possible. The systems or techniques mentioned above are not distinct, but overlap in many respects. The usefulness to Navy management of most of these mathematical concepts boils down to simple logic--that is, a logical approach to management problems.[1] The use of computers has amplified and

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[1] Ibid., pp. 126-127.

emphasized the need for a scientific approach which consists of five general steps: (1) defining the problem; (2) determining and quantifying the factors in the problem; (3) determining the relationship between the factors; (4) determining how the factors will be recombined; and (5) testing of and improvement of the model.[1]

The methods utilized in achieving this objective of the Navy program are worthy of a cursory understanding by all management personnel, and the fulfillment of this objective will allow the majority of the other objectives of the program to materialize. For these reasons a brief description of the mentioned methods follows. It should be remembered, however, that this is only a sampling of so-called scientific methods, and it is the application of all, as required, that must be the goal of Navy management.

Statistical Sampling

The techniques of statistical sampling include but are not limited to acceptance sampling, discovery sampling, and estimation sampling. Each system is a method of determining an acceptable sample size, based on the degree of error or confidence which is acceptable to the manager.[2] Statistical sampling permits a partial

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[1] Ibid., p. 120

[2] R. Gene Brown and Melville J. Draper, "Editing Financial Data for Management," The Controller, (April, 1962), p. 153.

review rather than a one hundred percent review with a predetermined degree of probability that the inferences drawn will be correct.[1] The technique includes the definition of the size of the population; determination of the sample size by acceptance sampling, discovery sampling, or estimation sampling; and the selection of the items to make up the sample. Acceptance sampling is different in that management determines the risk and maximum error standards, and then the size of the sample is determined by precomputed tables. Instead of getting a sample size for accepting or rejecting an error rate as in acceptance sampling, discovery sampling may be used. In discovery sampling the sampling is continued until the manager is convinced that the number of errors for the size of the sample is such that a sufficiently high level of confidence has been attained. Discovery sampling generally requires a smaller sample size and this is the reason for its more widespread use. Estimation sampling requires more time than the other two methods of sampling, and requires a predetermined sample size from which the error rate is necessary beforehand. The sample is taken, the error rate is estimated, and then the decision is made whether or not to accept or reject the error rate. Although estimation sampling has the disadvantages of a larger sample size and more complicated procedures, it does give a more specific estimate of the error rate.[2]

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[1] Ibid., p. 157.

[2] Ibid., pp. 152-156.

Stochastic Process

The technique of stochastic process is a branch of mathematical statistics just as the theory of probability and frequency distribution are branches. The stochastic process is useful when probability chains are involved. Time is generally an element in the stochastic process, and it has been compared to ". . . a game in which Mother Nature spins a wheel, and the event is determined by the spot at which the wheel comes to rest."[1] Like probabilities, the stochastic technique is not deterministic in stating what will happen in each particular event, but will give the long run proportion that will occur from each of a number of possibilities.[2]

Decision Tree

The decision tree technique clarifies the choices available to management and the possible payoffs of the various alternatives when the alternatives are reduced to probabilities. This method of diagraming the alternatives is not without limitations. The manager must:

(1) Identify the points of decision and alternatives available at each point.
(2) Identify the points of uncertainty and the type or range of alternative outcomes at each point.

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[1]H. Burman, Jr. and A. K. McAdams, "Financial Decisions and New Decision Tools," Financial Executive, (May, 1964), p. 23.

[2]W. Allen Wallis and Henry V. Roberts, Statistics--A New Approach (Glencoe, Illinois: Free Press, 1956), p. 8.

(3) Estimate the values needed to make the analysis, especially the probabilities of different events or results of action and the cost and gains of various events and actions.
(4) Analyze the alternative values to choose a course.[1]

The decision tree helps clarify the various courses of action and the effects of present and future decisions by a combination of the discounted cash flow and present value methods with statistical probabilities.[2]

Linear Programming

The decision process is improved by the linear programming technique because it takes into consideration a greater number of variables which are difficult, if not impossible, to evaluate on an intuitive basis, and because it provides information which is not otherwise available. Complex problems which have numerous administrative or technical restrictions in their solution, and a minimization or maximazation of one characteristic are solved with an optimum solution by linear programming which can measure the multiple effects of one or more change. The formulation of the problem in terms of straight line relationships and the quantification of the restriction or parameters can provide a matrix analysis of linear programming form. This will provide a unique solution to extremely complex problems. Although the

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[1]John F. Magee, "Decision Trees for Decision Making," Harvard Business Review, (July-August, 1964), p. 130.

[2]Ibid., p. 135.

problem must be one of a linear relationship for an optimum answer, an initial approximation can be obtained even when the relationship is not linear. The three major difficulties of linear programming are stating the problem, measuring the relative effectiveness, and choosing the factor which is to be maximized or minimized.[1] The personnel close to the problem must assist in the analysis to insure that proper parameters are set and that all critical variables are considered.[2]

Operations Research

In the operations research technique, as in most of the other techniques, the basis is the construction of a model or matrix to which applied mathematics gives reality by obtaining practical conclusions from the use of abstract mathematical reasoning. The drawbacks of intuition are minimized, and the decisions can be based on abstractions from the real world which, after being subjected to mathematical analysis, are the basis for prediction.[3]

The basic steps in operations research are in reducing objectives to quantitative terms in determining the factors or variables which influence the objectives and in asking questions which can be answered in terms of the realities of the situation.[4]

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[1] A. C. Rosander, "Linear Programming in Financial Management," The Federal Accountant, (June, 1962), pp. 138-140.

[2] Ibid., p. 147.

[3] Albers, op. cit., p. 208.

[4] Ibid., p. 209.

All of the limiting, complementary, and competing factors in the situation must be represented in quantitative terms in the model either as an absolute or an inequality so that each factor and relationship is clearly shown and considered in the solution. Any change in one of the factors or relationships will bring a wide range in the change of alternatives or possible solutions. This technique of operations research is far more suitable than the trial and error technique because it takes in so many more variables and considers so many more interdependent relationships. The very defining of the problem in operations research becomes a part of the answer and is highly significant.[1]

Correlation Analysis

Another form of operations research is correlation analysis which uses the least squares method to provide the equation of the line for multilinear and curvilinear correlations as well as simple linear correlations.[2] The advantages of correlation analysis are the minimizing of individual errors over a time span, the capacity to predict the limits of variance, and identifying the causes of future errors through the predicting equation.[3]

PERT

An advanced method to aid decision making is Program Evaluation Review Technique or PERT, which was developed to measure

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[1] Ibid., p. 211.

[2] Robert A. Knapp, "Forecasting and Measuring with Correlation Analysis," Financial Executive (May, 1963), p. 17.

[3] Ibid., p. 13.

progress in research and development projects. PERT was originated as a system to measure the integrated influences of time, resources, and technical performance with the view to completing objectives within the deadline. Due to the time period, specific projects having less time than any other factor, time was used as a common denominator to measure progress.

The first step in establishing PERT is the making of a network chart which shows all significant events to be accomplished in meeting the objective. The network chart shows all the dependent relationships (interfaces) between the events (benchmarks) and shows the order in which they have to be accomplished. The second step is in getting estimates of the time to complete each event or benchmark.[1] The routine which was followed in getting the estimates from knowledgeable personnel was that of getting three estimates: optimistic time, most likely time and pessimistic time to complete. The most likely time was multiplied by four and added to the optimistic and pessimistic times to complete. The resulting sum was divided by six and yielded the estimated to expected time of completion. Later uses of PERT have utilized a one-time estimate which was neither optimistic nor pessimistic. Both systems of time estimates have yielded good results.

The network of interdependent time estimates blueprints the progress as it must occur under the present plan, estimates

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[1]Willard Fazar, "The Origin of PERT," The Controller, (December, 1962), p. 598.

the uncertainties in achieving major objectives, and highlights critical areas as well as slack areas as the work progresses. PERT shows the network path which will take longer to complete than any other path. This is known as the critical path and is the greatest danger to success. The change in the completion outlook is automatically updated as work progresses. The consequences of decisions can be simulated on the computer to evaluate the decisions thought to be optimum. The information needed by the various levels of management can be provided to each level separately by PERT. It also eliminates "crash" programs due to identifying problems early enough for managers to take preventive actions. The foregoing advantages of PERT are being extended from a system based on time to a system based on time/cost and are being applied to many areas outside of research and development.

PERT is like all of the previously mentioned decision techniques in that it does not make decisions and is not a cure-all, but does provide more information and a sounder means of evaluating the critical variables upon which management can exercise its judgment in making decisions.[1]

In each and every system of model building the manager must assist in defining the factors and their relative weights and relationships. Each system utilized requires parameters which should be decided by the manager, and then the system can provide

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[1] Ibid., p. 599.

the information on which the manager can base assumptions or parameters; these changes should be incorporated into the computer. One of the advantages of the simulation technique is the ease of changing assumptions and the repeating of simulation with little or no change in the program.[1]

The primary prerequisite for any decision or any computer system is logical reasoning. The assessment of the future and the determining and weighing of critical variables in a quantitative model are still dependent upon the judgment of the manager, and in this manner experience and rules of thumb will always influence quantitative approaches and systems.[2]

It must be remembered, however, all such services and methods hoped to be achieved by the Navy program, represent essential information to (not replacement of) management, and moreover will have an effect in determining the optimal management structure itself: i.e., organization, information systems, and physical facilities and processes involved in the conduct of management.

Economic Balance

The objectives here are: (1) an optimal use of whatever resources are allocated to information systems, and (2) an optimal

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[1]Richard N. Schmidt and William E. Meyers, Electronic Business Data Processing (New York: Holt, Rinehard and Winston, 1963), pp. 434-441.

[2]Bierman, op. cit., p. 23.

balance between Navy resources allocated to information systems and resources allocated to all other things. The objective is to get the best information system possible out of all the resources allocated thereto, no matter how much that is, and the overall objective is to allocate the right amount to information systems. Then, the point of best total economic balance is reached when any further change therefrom, in expenditure on information systems, will decrease the effectiveness of the entire Navy with all its resources. The economic principle of marginal utility applies here. On one extreme, if no Navy resources were allocated to information system, Navy military effectiveness would be very low. On the other extreme, if all Navy resources went into information systems there would be no military effectiveness at all. Somewhere between them is the high point. The proper balance is required to optimize Navy effectiveness. Reaching this objective may well require an increase in total Navy resources allocated to information systems in order that all remaining resources, though reduced, can do more.[1]

Summary

In this chapter the objectives of the Navy ADP program have been reviewed. The purpose of the entire program is management improvement, which is in essence the same as more informed management decisions. The tools and methodology in arriving at these decisions are ADP equipment and proper use of management sciences, respectively.

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[1]Dillon, op. cit., p. II-11.

The goals management should be striving for are both short range and long range, with the long range goals being those attainable in the foreseeable future. A constant search for the proper economic balance of resources to achieve these aims appears to be a logical conclusion to the material in this chapter.

What should be remembered is that the Department of the Navy is a viable organization; it is dynamic rather than static, and by no means do the objectives stated form the end in themselves. The uses of data processing are constantly changing and because of this, objectives, techniques, methodology, etc., in themselves will be undergoing change.

The chapter which follows will show the plan or stages whereby the objectives mentioned are hoped to be achieved, and how the program has materialized over the years. It also will point out where a major problem area is, and what some applications/ implications are concerning the use of ADP systems within the Naval Establishment.

CHAPTER III

THE PLAN TO ACHIEVE THE OBJECTIVES AND APPLICATIONS/IMPLICATIONS

In an effort to find where it was, where it had been, and where it was going, the Navy in 1959 reviewed the entire ADP program. Upon completion of the review, in order to gain a perspective of past, present, and future expectations for planning purposes, time frames (periods of accomplishment) were devised. These are referred to as time stages.

There are six stages, each covering a period of five years starting with 1940. Stages one through four covered the period from 1940-1960; stage five, the period just completed (1960-1965); and stage six completes the planned time period and covers the years 1965-1970.

Although stages one through five have expired, in order to provide the proper perspective of Navy plans to achieve the total objectives, an explanation of this period is also of value and is included in the discussion which follows.[1]

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[1] Ibid., pp. II-1-II-4.

Stage 1 (1940-1945)

This was the period when military demands for scientific and engineering results required mathematical calculations that took many people too long to do. To meet this need, the first electromechanical and electronic digital computers were developed, designed for high speed evaluation of formulae. Typically in this kind of work, relatively little data go in and come out of the computer, but a great amount of computation is done in the machine. This period, then, produced the electronic computer for scientific work.

Stage 2 (1945-1950

This was a period of considerable expansion of scientific and engineering computation equipment. It was the shakedown of machine logic, settling on the digital binary electronic circuitry and other properties that will be found in almost all electronic computers at least through Stage 5. This period also developed basic specifications, prototypes, and economic feasibility of electronic computers modified to do logistics and business type work. Typically in this kind of work, a large amount of data go in and come out of the computer with relatively little computation in the machine. The scientific computer had to be modified for economy, alphabetic capacity, etc., but the most important modification was the addition of devices for preparation, input, storage, and output of data. This period,

then produced the first crude automatic data processing equipment for management.

Stage 3 (1950-1955)

This was the period which began the era most of us are familiar with today when we think of Automatic Data Processing. It was during this time frame which accomplished the awakening by management in government, military, and industry (and by equipment manufacturers) to the vast potential of electronic means to do all the costly ever inadequate "paperwork" that must be done. With good reason, management began to see a possible savior from its informational travails. This time frame saw the following take place: (1) widespread actions to acquire ADP were initiated; (2) the potential of ADP was confused with the limited capacity of Stage 3 equipment; (3) expectations of the advantages of ADP were exaggerated; (4) anticipation of the pitfalls of ADP was generally lacking; and (5) the equipment was not yet very good.

There were a few pioneering installations during this period, and Stage 3 ended with hardly any really productive system, but a great many feasibility studies, orders, plans, and intentions. In recognition of the great potential of ADP for both good and bad, the Department of Defense established organizational and procedural means from the highest levels to control the evolution of ADP in the military.

Stage 4 (1955-1960)

This was a period of initial acquisition in quantity of the first generation of feasibly useful equipments and saw also the following take place:

1. The initial organization and development of ADP personnel.

2. Development, test, and refinement of initial applications.

3. The refinement and other shakedowns of equipment and equipment producers.

4. Effectiveness of ADP for management.

Stage 4 was essentially an initial acquisition and earliest feasible applications, quick payoff, and pilot installation period. Generally, there were no fully and economically productive ADP installations at the beginning of Stage 4, but by the end of Stage 4, roughly there were productive ADP installations at all activities which warrant the use of ADP. Also in Stage 4, the same kind of early awakening that Stage 3 evidenced toward the electronic computer itself was directed toward source data automation, communications, and the management sciences adjuncts of computers. Stage 4, it was anticipated, would produce the first crude concepts and nuclei of equipment, personnel, and techniques to begin a natural and evolutionary movement toward adequate management.

Stage 5 (1960-1965)

Insofar as the Navy was concerned, it was intended or expected that this stage would be characterized chiefly in the following eight ways:

1. Completion of a special comprehensive evaluation of all experiences with Stage 4 equipment.

2. Extension of Automatic Data Processing systems experience and consequent development of technical and management personnel throughout all levels and key centers of Navy management.

3. A growing awareness and working familiarity by management of the full potential values of ADP and how to use it, particularly in conjunction with applied management sciences.

4. Shift in emphasis of applications toward the best use of ADP, predominantly in development of plans, programs, budgets, schedules, and management control actions. This was in addition to the common uses in records, reports, and general substitution for clerical paperwork.

5. Shift in overall program emphasis away from review and monitorship of plans and projects decentrally developed toward more centrally developed techniques. This was not only the case in ADP applications, but in a scientific approach to the design of optimal information systems themselves, using operations research and similar methods in so doing.

6. A maturity of hardware, in three ways: one, as it is improved in cost, size, ease of use, speed, and other capacities;

two, as a full range of information systems equipment (source data automation, data processing, data storage and retrieval, communications, final delivery or display) is developed; and three, as it (ADPE) approaches its inherent limits of usefulness to Navy management.

7. The development of an overall plan for an orderly transition, Navy-wide, from the heterogeneity and technical infancy of Stage 4 equipment to a full complement of adult equipment. The adult equipment is to have appropriately standard or common properties, Navy-wide.

8. The beginning of the transition itself, in accordance with the plan outlined in the preceding seven items.

Since this period is the time frame we are just completing, it would appear as though these plans of Stage 5 should have materialized. One area in particular appears to be a major stumbling block and not as easy to accomplish as would first appear. Reference is made to item three above. This particular planned item, management's knowledge and use, if accomplished completely, should lead to the accomplishment of all goals and tasks.

Even though gains have been made in this direction (relatively), it would appear that this is not such an easy task to accomplish. Even as late as 1963, Mr. Edmund D. Dwyer, then Chief, Navy Management Office, while testifying before a House Subcommittee stated:

> . . . Another weakness in the Navy is that Navy management is still incapable of fully exploiting its already existing machine capability.[1]

The statement points out the educational task required to bring management to the point of being able to fully achieve the Navy's ADP program objective.

It is also interesting to note that this failing is not limited to the Navy, but the same holds true for the entire field of ADP applications or uses, and is a consequence of the computer age developing faster than management's ability to keep up with it. Another writer in the field states:

> Cybernation is still in its infancy, and present day computers are under used; under used meaning that not even a fraction of their potential is tapped.[2]

Another source says basically the same thing:

> Unfortunately, man, in spite of his centuries of preparation, has not yet completely adjusted himself to the computer age. A recent survey of companies with long computer systems experience indicates that the major problem in the transition to EDP is not technical, but managerial and organizational.[3]

A recommendation of Mr. Dwyer, speaking for the Navy, was the consideration of a local government-sponsored ADP complex to fulfill a threefold function, one of which would be to act as a

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[1]Use of Electronic Data Processing Equipment, Part 1- Comptroller, op. cit., p. 112.

[2]Allice Mary Hilton, "Full Employment and Human Tasks," Data Processing Magazine (July, 1964), p. 33.

[3]Woodbury and Cavit, op. cit., p. 3.

management sciences academy. This academy would serve as an educational tool for the enlightenment of top management as to the potential of machines and mathematics in the service of their decision making and attendant management responsibilities.

Although not called a management sciences academy, the Department of Defense late in 1963, gave to the Navy the responsibility for establishing a "Defense Computer Institute" in the Washington, D. C. area. A memorandum issued by the Deputy Secretary of Defense in November, 1963 concerning this institute states:

> The Department of Defense does not have sufficient in-house technical capability in the planning and implementation of digital computer systems, especially in command and control. In view of the trend to establish increased numbers of these systems, it is important that this shortcoming be remedied. I desire to give to DOD personnel who have management responsibilities concerned with information processing systems the necessary background in digital computer usage that will enable the Department of Defense to lesson its dependence on contractors. The purpose of such a course would be to teach the fundamentals of digital computer capabilities, limitations, techniques, and applications to enable senior military and civilian personnel to play a greater role in the planning and implementation of new digital computer systems and in improving existing ones.
>
> A considerable amount of computer training is done within the Department of Defense at the present time. Nevertheless, a review of the total military computer training effort indicates that the courses are fundamentally oriented for personnel who will operate, maintain and perform computer programming. Very little training is being done for senior managers

> and executives who are faced daily with broad-guage decisions and policies relating to information processing systems, yet have very little training in the technology and use of such systems.[1]

The Department of Defense is certainly aware of the problem, and at present the "Defense Computer Institute" is a reality. It is an adjunct of the Naval Command Systems Support Activity (NAVCOSSACT) in Washington, D. C. (This naval facility is involved in computer usage, information systems development, and computer programming work).

Two courses of instruction are offered to officers of all the military services and Department of Defense civilian managers. One course is of two weeks' duration and is designed to meet the needs of generals/admirals, and equivalent civilian counterparts. The other course of three months' duration is conducted for the lower echelon of management, such as major/lieutenant commander, and up to flag rank personnel and their civilian equivalents.

This coupled with other training and educational programs now in existence within the Naval service, is a method whereby the Navy will add to its corps of individuals who should be able to utilize fully the potential of ADP equipment as managers.

Stage 6 (1965-1970

It is expected that early in this stage the Navy will have installed (and interconnected) a full range of ADP equipment, with

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[1]R. A. Gilpatrick, A memorandum concerning Computer Institute for DOD Executives, Washington, D. C., November 19, 1963, pp. 1-2.

adequate technical personnel on board, having the capability to attain all of the long-range objectives mentioned in Chapter II. It is expected that at the end of this stage those objectives will be routinely achieved throughout the Navy in actual hourly operations. Therefore, developmental activity during the period will be chiefly in the perfection of the best ways and means for management to use the advanced equipment and technical personnel--at its disposal Navy-wide. The end result of Stage 6 should be the ultimate management exploitation of "Automatic Data Processing Systems" in AN INTEGRATED NAVY MANAGEMENT INFORMATION SYSTEM.

Applications and Implications

Following is a brief description of four general areas of application and implication, which show how the objectives and plans of the program are materializing and what they can lead to in the future. The areas chosen for this overview are:[1] the Navy Cost Information System; Naval Personnel Management; Automation of Military Pay and Allowances; and Computerized Training of Naval Personnel.

The Navy Cost Information System[2]

In its broadest aspect, the Navy Cost Information System (NCIS) must be viewed as that system within the Navy through which

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[1]The four areas as presented are adapted from separate research projects by members of the Naval Graduate Financial Management Program, The George Washington University, Washington, D. C., 1964.

[2]Adapted from an unpublished paper prepared jointly by D. Allen, J. Bair, and P. Brookshire, "Important Uses of Data Processing in Department of Defense," The George Washington University, 1964, pp. 7-13 (mimeographed).

all financial information flows. It parallels the functional responsibility and authority of the Assistant Secretary of the Navy (Financial Management). It might also be thought of as a functional system that crosses organizational lines, for the scope of the NCIS includes any unit that maintains and reports cost data that are used by management echelons in the Navy Department.

The NCIS, as it exists today and as it will evolve in the immediate future, can play an important role in the planning-programming-budgeting-appraisal cycle. It is the vehicle for the input of financial data which, when wedded to program data, becomes a meaningful tool for management decisions, review and appraisal.

It must be recognized here that NCIS is very definitely tied into the programs of the Secretary of Defense in a slightly fluid position. It is within the context of this fluid situation--the flow of modifying plans, recasting programs with the ensuing impact upon the budget, and the evaluation of the budget execution--that the NCIS becomes immeasurably entwined.

The cost information system consists of a library of basic data representing cost, quantities, and characteristics of physical resources, and a procedure for updating. The system is the basis for reports to inform management of status, and to provide tools for control and decision making. The system can provide data for survey of plans, development of the five year force structure and financial plan, updating of programs and budgets, control of

program levels, pointing out exceptions and directing attention to problem areas requiring action, and alerting action officers and assisting them in solving problems.

The implementation of the Cost Information System is in three parts:

Part I--Structure for Interrelating and Updating Program and Budget Data.

Part II--Structure for Integrating Report of Progress Against Program and Budget Plans.

Part III--Structure for Integrating Material Readiness into the Information System.

With the inception of the system for programming on a total resources basis, as developed by the Office of the Secretary of Defense, the Department of the Navy was faced with the need for providing data on forces and their costing on a different basis than was called for by the existing management and financial structure. To do this certain information was required. Data on forces and related costs, compatible with the Secretary of Defense's programming structure and at the same time, budgets in terms of the existing appropriation system. Presentations would be necessary which would not distort Navy and Marine Corps programs and financing but would also maintain consistency with Secretary of Defense requirements.

The cost information system was devised to meet these requirements and still permit the Department of the Navy to plan

and operate on the current basis, where necessary. Under this system the Department of the Navy can continue to examine data on forces in customary management groupings as well as by Secretary of Defense elements. For example, the Department of the Navy must know the status of all escort picket ships regardless of where they appear in the defense element structure, with respect to research and development, investment and operating costs, and numbers.

The cost data submitted under this system are identified so that they correlate meaningfully with program information, such as numbers and types of ships, aircraft, missiles, and indices of the tempo and intensity of operations.

The input for such a cost system must be shown in terms which will not sacrifice management planning and control requirements at the Department of the Navy or the Department of Defense level.

The system makes it possible, through the use of computers applied to appropriate inputs, to relate financial and nonfinancial data to programs and elements, and to provide these data to staff analysts in familiar terms. In addition, it can provide major procurement item quantity data and operating data, such as flying hours and ship overhauls, without regard to program and element, and identify material in procurement account to permit decisions and control of funds programmed for investment. The system makes provision for each major facet of a program to be considered, either in total or in relation to the other programs.

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The system for accomplishing this relationship is the use of codes for each major program aspect such as activity, item, appropriation, etc. Bureaus, offices, and the Marine Corps provide inputs in accordance with these codes.

The code category called Naval Cost Centers permits the ready conversion of Naval management entities to Office Secretary of Defense programs.

The appropriation code generally provides for a conversion of the appropriations to the project level. This does not mean that all appropriations must be converted to the project, but rather that provision exists in the system to do so. For example, since military personnel costs are statistically factored by the number of persons, it is not desired to convert that appropriation below the appropriation level in relating cost to program elements. However, in the case of the operation and maintenance, Navy, appropriation, provision is made for a conversion below the budget project level.

A conversion of the Office of the Secretary of Defense cost categories (Research and Development, Investment, Operating) is referred to as a stub code and provides for program data such as flying hours, number of overhauls (ships) and aircraft overhauls.

A special code provides identification of individual items of equipment or projects and groups them into large categories, such as ships, aircraft and missiles, research and development projects, and military construction projects.

The identification as to whether the item under consideration is a budget presentation item or an item designated by the Office of the Secretary of Defense as a program element item will allow the computer to select budget presentation items from the input data and print them out.

The objective of such a cost information system is to produce outputs which will meet analytical and decision making requirements with respect to planning for the future and program control for the present, as well as reporting requirements of the Office of the Secretary of Defense. Such outputs include a wide variety of reports showing interrelationships which can be brought to bear on management problems. The following are some of the reports planned as outputs:

1. For purposes of Secretary of Defense analysis, costs shown in terms of program elements, grouped in terms of programs and elements and broken down minimally into three cost categories; namely, research and development, investment, and operating.

2. For budget presentation, appropriation and subdivision listings.

3. The cumulation of data in terms of the Department of the Navy force structure, the support of the forces and the related costs.

4. The relation of forces to procurement items and research and development and military construction projects and the associated costs.

Each of the above outputs will represent plans for the current year, the budget year, and at least four more years projected into the future. For the current year, actual performance must be capable of being reported in the same terms as the outputs. For the budget and future years, all adjustments to plans must be capable of being translated into each of the outputs.

Outputs can be shown in more detail than by element and appropriation structure. The element structure, for example, in item (1) above is made up of stub entries within each of the cost categories and must further include allocation of costs from resource category line items such as aircraft, missiles, and torpedoes. The appropriation structure in item (2) above breaks into major activity, budget activity, and budget project.

The breakdown of the element structure into stub entries will permit an analysis of effectiveness for varying levels of operations and for different degrees of intensity of operations. The decisions based on these analyses will determine the level of procurement for the major units of equipment making up the procurement section of the element. The research and development covers the cost of seeking improvements in the capabilities of the units of equipment.

In order to utilize information generated by this system we are faced with some problems and developments for the future. In an unpublished paper Commander Jack W. McCabe, USN, of the Office of the Navy Comptroller has summarized some of these items.

The ideas now presented are from his paper and with interviews with him.

Rapid response is a function of time. Time can only be gained through converting more and more of the segments of the planning-programming budgeting sequence to computer input. Fortunately this is being done. The needed system and computer programs are now under development which will rapidly respond to management's requirements through a complete cost information system.

This system will enable naval operations planners to develop the program objectives into numerous probable force structures that can be translated onto magnetic tape to reflect a time phased program of ship forces by hull number, aircraft forces by model and type, etc. It will also enable the bureaus and offices to process this computer tape into their computers which are to be programmed as cost models. Each of the probable force structures would be priced out by: appropriation detail, naval cost center, stub code (research and development, investment, operations), and resources category items (quantities and dollars).

These computers would also indicate military construction project requirements. For example, if this probable force structure called for ten aircraft squadrons at a given naval air station and the current facilities could only accommodate nine squadrons, the machine would price-out the military construction project for the additional facilities required.

It must be recognized that there are other computer outputs that will be vital to Navy management in the day-to-day decision making process. It will provide a capability for cost-effectiveness studies. It will enable management to measure performance against plan particularly in the procurement area in order to take early corrective action where necessary. It will provide the cost of programs and weapon systems and components for analysis and evaluation. It will relate and display all the resources required for a given program and their costs. It will display the tempo of operations of forces and their supporting units with associated costs.

Related systems under development include one which is a ships planning system which will provide and maintain current data on ship inventory and status, conversion and overhaul schedules, ship equipment allowances, and tempo of operations. This ship planning data will be identified to Naval Cost Center (NCC) to insure that ships forces and their associated costs are aligned to the same program element. A similar system is being developed for aircraft.

The most difficult segment of this "systems to cost center" communication capability lies in creating the computer cost models in the bureaus and offices. The problem here stems from the manner in which this mechanized system first developed. Time did not permit a searching analysis to reconcile the bureau budgeting methods, in being at that time, with some preconceived ultimate

objective. In fact, many were of the opinion that the Navy should not modify any systems but merely meet the Secretary of Defense requirements with a minimum amount of effort. It is now recognized that if these are the ground rules for program and budget decisions by the Secretary of Defense, it behooves the Navy to realistically examine their programs and budgets within the same framework.

With this as a point of departure, the Navy realizes that both ends of this planning-programming-budgeting sequence are fixed. That is, Naval planners must begin with the program objectives and NAVCOMPT must convert the Navy programs into Secretary of Defense program elements identified with the five year force structure and financial plan. Therefore, the greatest emphasis must be made to achieve uniformity in the cost models being built in the bureaus and offices. This is a prerequisite to this envisioned method of providing system to system communication with machine readable tape.

It must be kept in mind that the various systems are not competing ones. The systems exist to provide information where needed. However, the goal is ultimately one unified information system. The Navy Cost Information System is not in existence to provide decisions--only to provide the means for better decision making.

Naval Personnel Management[1]

In recent years the personnel strength of the Navy has been approximately 670,000 officers and men. About 600,000 of the total

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[1]Adapted from an unpublished paper prepared by R. Legare, "Implications of Automatic Data Processing in Naval Personnel Management," The George Washington University, 1964. (Mimeographed)

are enlisted personnel.

One must bring into focus organizational objectives of the Navy in order that ADP implications may be intelligently assessed in relation to the objectives which the Navy must achieve. Business has an objective which is different than that of the Navy. Business exists to make a "profit," whereas in contrast, the Navy has an objective (or mission) which is "the projection of power from the sea in support of our national purpose." Our national purpose is defined as "maintaining our freedom." Secondly, a caution is advanced in regard to translating procedures, principles, etc. from one type organization to another. In this regard, ADP for the business society serves as a means to reduce manpower and thereby increase profit. ADP used in Naval personnel management can likewise reduce personnel in the support force. In contrast, however, rather than "fire" these personnel, the Navy can "trade off" support ratings for operational ratings. Thus it is seen as a practical management tool.

The personnel management process entails three main elements--procurement, training and placement. Two functions, selection and distribution, are implicit in each of the elements. Currently enlisted personnel management is accomplished in the Navy through the "Manpower Information System." This system started in 1955.

The focal point of the Manpower Information System is the Data Processing Center in the Bureau of Naval Personnel. Data are

forwarded to the Center from the three Personnel Accounting Machine Installations (PAMI). The PAMI installations provide information to the three Enlisted Personnel Distribution Offices which exercise control over ninety-four per cent of enlisted strength. The central processing unit is equipped with the IBM 7080 computer with two periferial IBM 1401's. The PAMI's are currently using IBM 1401's.

The system has the capability to provide reports containing such items as (1) inventory of personnel by pay grade and occupational skill, (2) expiration of enlistment, (3) advancements, and (4) basic test battery scores. The system provides a wealth of information. Very little would be missing if the personnel situation were one of surplus; however, the fact is that there is a shortage of trained technicians. Accordingly, a personnel management system is needed which can best balance the available manpower and integrate personnel requirements into planned weapons systems.

Concerning future implications of ADP in the personnel management field, ADP potential is seen to offer the possibility to manage by "projection," and manage by "exception."

Programs now in progress include "Moon" and "Capri." Project Moon is the code name for the Enlisted Personnel Simulation System. Capri is the name for Computerized Advance Personnel Requirements Information. The feasibility study for Capri has been completed; the system design phase is nearing completion. Three

pilot test programs are in progress. Moon, though much input data are yet missing, is operational.

Capri will provide a management tool which will allow planning and control of personnel training requirements integrated with new naval weapons systems. It will treat "personnel" as a major "subsystem" of each weapons system under development.

The Moon simulator will provide management with means for a horizontal measurement of manpower throughout the entire Navy. The system projections are based on existing policies, planning and actuarial factors which summarize voluntary behavior of enlisted personnel. Variations to existing factors can be introduced and the resulting changes predicted.

There is little evidence thus far of thought being given to the following additional ADP possibilities in personnel matters, but they are possible.

Management by Exception.--This could provide reduced administrative work in the field and operating units. This could be achieved by doing away with the need for reporting personnel status changes in such areas as promotion, transfer, receipt, etc. Such reports will be "by exception only."

Reduce Field and Operating Administrative Workload.--Eliminate the need for much of the "leg work" in personnel management, such as the need to manually screen personnel records to determine basic qualifications for programs such as college programs and the like.

Management Levels.--In this area, ADP can allow the Navy to achieve such things as eliminating the Enlisted Personnel Distribution Office management level. This would achieve economies by reduction in use of real estate, personnel; and would allow central distribution "by computer" of all enlisted personnel.

The foregoing certainly looks bright. In each case the Navy is able to "reduce," "economize," and "project plans." If the Navy were a commercial business with the primary objective being to make a profit the discussion could end at this point. However, as will be recalled this is not the mission of the Navy. Accordingly, two important points must remain clearly in focus when one considers the use of ADP in personnel management: (1) There is a danger of misapplication of principles, concepts, procedures, etc. when attempting to transfer experience from one type of enterprise to another, and (2) it is important to recognize that all organizations exist to achieve an objective.

Automatic Data Processing must be recognized as being a practical management tool. The naval personnel manager must bear in mind that the computer is available to provide him with the information required. It is his obligation to make the decisions, including moral and social ones.

Automation of Military Pay and Allowances (Marine Corps)[1]

In October, 1962, the Department of Defense issued Directive 7040.3 which had as its objective the improvement of military appropriation management through use of program and financial management systems which equate personnel, financial, and other resources throughout the planning, programming, and budgeting cycles. This Department of Defense (DOD) Directive ordered the services to furnish the Secretary of Defense by December 31, 1962 with a time-phased program in terms of specific projects which would lead to full implementation of the directive not later than October 2, 1964. However, as of October, 1964, no service has been able to implement a pay and allowance system to fulfill the requirements of this directive. The Marine Corps presently has a target date of July 1, 1965, to have their proposed mechanized pay system approved and implemented.

As a result of the issuance of DOD Directive 7040.3, a Headquarters Marine Corps study group was appointed to analyze the directive and to develop a recommended concept of accomplishing its requirements. The study group found that the real clue as to what would be involved in achieving the basic objective of the directive lay in the section pertaining to required reports such as actual versus planned obligations, actual versus planned collections, and actual versus planned disbursements to date, which were to be submitted to DOD monthly or as requested. After a very critical

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[1]Adapted from an unpublished paper prepared by R. Wakefield, "The Proposed Automation of the Marine Corps Pay and Allowance System," The George Washington University, Washington, D. C., 1964. (Mimeographed.)

examination, it was concluded by the study group that the Marine Corps' present essentially manual disbursing system could not possibly produce the massive amounts of data involved, on a sufficiently timely or accurate basis to satisfy the requirements of DOD Directive 7040.3. Since a manual extraction from the pay accounts was determined impractical, automation of some sort was indicated, and the study group then examined a variety of currently operable and proposed disbursing methods. The eventual selection was a concept which would replace the current single pay record hard copy with a multi-punch card pay account which will be processed on a computer to calculate pay due, prepare payrolls and checks, and produce the accrual accounting data pertaining to pay and allowance obligations and expenditures.

Three of the major problems that the study group determined the Marine Corps would encounter in automating its pay and allowance system are as follows:

1. Regional consolidation of disbursing offices will be necessary under a mechanized system. In order to obtain maximum use from computers and personnel it will be necessary to establish disbursing offices, supported by computer-equipped data processing installations, for the payment of as many individuals as practical within given geographical areas.

2. Some mobile computer-equipped data processing installations must be available even though not always actively engaged in support of a military pay function. To remain as a

force-in-readiness and to be responsive to a war-like situation, the Marine Corps must retain the capability to deploy when and wherever directed. Likewise, the timely and accurate payment of troops and reporting of accruals must be responsible to changing situations and probability of rapid deployment.

3. A mechanized system will generate the need for major revision of regulations, extensive personnel retraining, and Marine Corps-wide personnel orientation.

These problems have been or will be resolved in the following manner:

a. The Marine Corps now has, or is in the process of installing, twenty-seven IBM 1401 punched card computer systems, three of which are mobile mounted at various installations throughout the Marine Corps. These computers will provide the necessary data processing support to implement the automated pay and allowance system.

b. The Marine Corps plans to establish two schools, one located at Marine Corps Schools, Quantico, Virginia, and one at Camp Pendleton, California, to train the personnel required to operate the new system. The Marine Corps does not envision any reduction in manpower requirements in its disbursing organization until the time-consuming job of converting to the new system is completed, and then only experience will determine the number of personnel required to keep the new system operating.

Capabilities of the proposed Mechanized Pay System are as follows:

1. Entitlements earned will be obtained from the individual pay account and established as costs during the months in which entitlement is accrued.

2. Monthly reports of entitlements earned and gross disbursements made will be prepared in detail sufficient to permit the accurate computation of costs by pay grade and program element.

3. Obligations will be liquidated against the same fiscal year account for which they will be established.

4. Entitlements earned and disbursements made will be equated against budgetary estimates for periodic progress reports, thus providing for evaluation and adjustment of Total Obligational Authority, where necessary.

In planning for the automation of the Marine Corps Pay and Allowance System, the study group was unable to take advantage of any existing knowledge or procedures in the business world since no business firm has comparable requirements that must be met by a military pay system. The study group feels that it has solved all the problems encountered in planning for the automation of the pay system. In addition, the study group feels that it has come up with the best system that could be devised, taking into consideration the funds and computers that are presently available to implement the system. However, it feels the proposed system could

be improved if the Marine Corps could obtain the funds to buy more sophisticated computers with which to process the required data, but this doesn't appear feasible at the present time.

The Department of Defense has only approved the implementation of the proposed Marine Corps Mechanized Pay System on an interim basis since DOD has as its long-range goal a joint unified military pay system. As a result of this long-range goal, the Department of Defense has recently appointed a study group consisting of representatives of each of the military services to look into the feasibility of such a system. The joint unified military pay system is just part of a plan whereby the Department of Defense hopes eventually to be able to receive almost instantaneous replies to any question it may pose concerning the status of any element in each of the services. The major requirement of such a system would be the integration and compatibility of the various services' personnel and pay accounting systems since a pay system derives its source data from the personnel accounting system. At the present time each of the military services has a different personnel accounting system which means that before a joint unified military pay system will be feasible, the services must adopt a common personnel accounting system. Therefore, it is in this area that the Department of Defense study group on joint unified military pay must apply its major research effort.

Computerized Training of Naval Personnel[1]

Educators and industrial training directors became increasingly aware of the limitations imposed by the traditional classroom approach to learning. Some of these limitations are:

1. The individual learning rate is directly related and therefore partially limited to the average progress of the class as a whole.

2. Time limits the degree of interaction between the teacher and the learner; thus the student is more passively than actively participating in the process.

3. Slower students meet with failure or at best minimum success despite their best efforts. This very often leads to lack of interest.

These limitations are converted into dollar costs for industry through training time expended, employee turnover, and, in some cases, mistakes caused by inadequate training. The educational system, although concerned with dollar costs, is faced also with the social implications of the limitations.

A new approach was called for and the concept of programmed instruction, previously restricted to the laboratories of experimental psychologists, found greater acceptance as a practical

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[1]Adapted from an unpublished paper prepared by W. O'Connor, "The Implications of Programmed Instructions for the Training of Naval Personnel," The George Washington University, Washington, D. C., 1964. (Mimeographed.)

tool to aid in overcoming these deficiencies. Programmed instruction is based on the fundamental principles of learning which state that the individual learns better if given only small increments of subject matter at one time; participates actively in the process; is appraised immediately of his grasp of the subject matter; and is continually motivated through a high degree of sucoess.

If instruction is viewed as a system of communication and control processes, the benefits of programmed instruction can be more readily appreciated. Under the traditional approach the teacher both prepares the instructional material and implements the instruction. During the instruction implementation phase the teacher seeks feedback in the form of answers to his questions. Based on this feedback, but severely limited by time, the teacher evaluates the group progress and then exercises the necessary controls upon the student and/or subject matter to achieve the desired level of learning. This communication and control process commences to deteriorate rapidly in effectiveness as the number of students per teacher increases beyond a few.

Under the programmed instruction the instructir's function is generally limited to the preparation of the subject material in a programmed form. The implementation of the instruction is the function of the prepared program and the device used for its presentation and feedback to the student. This man-machine system composed of the individual learner, the program and the teaching

machine provides for continuous communication and control throughout the entire learning process.

Programs are generally two types. First and the most common is the linear program through which all students, regardless of learning capacity, follow the same identical steps. The second type is the branching program. This program makes allowances for individual ability in comprehension and has alternative sequences built into it to permit different routes to be followed by each student based on his knowledge. Under this type of program an incorrect response will lead the student through a set of remedial steps or frames to enhance his grasp of the subject matter.

Using the word "machine" in its generic sense, the simplest teaching machine is the programmed text. Generally these texts utilize the linear type program but there are some minor exceptions. Their advantage lies in low cost and portability. The major disadvantage is that they are not adaptive to individual differences.

Another teaching machine currently in use is the partially adaptive machine which actually consists of hardware. These machines also generally employ linear programs but have the ability to re-present material with which the student experiences difficulty. In addition, such machines are cheat proof and provide a permanent record of the student's progress. The more costly machine of this type does have the ability to employ branching programs.

The most advanced teaching machine combines digital computers with branching programs. Such machines are nearly fully

adaptive to the individual student. These machines collate the present and past responses to the subject matter and the time required for response to determine what material is to be presented. Its only limitation is the size of its library and the degree of complication of its program. Such machines are currently in use in several research laboratories. An example of one such machine is the one in use at the Coordinating Science Laboratory of the University of Illinois. Although using only a medium size computer, it has the capability of teaching 1000 students simultaneously in eight different subject matters.

In addition to teaching, these machines have the ability of performing many of the administrative tasks of instruction such as scheduling, billing, preparing examinations, and grading.

The United States Navy operates one of the largest training organizations in the world. The Bureau of Naval Personnel manages 125 schools offering over 420 courses. When one adds to this the training conducted by the Naval Air Technical Training Command, Commander Fleet Training Centers Atlantic and Pacific, and the many other activities responsible for training of personnel, the aggregate task is of gigantic proportions.

Computer based instruction offers the potential for a breakthrough in the training of Naval personnel. Such machines can impart subject matter and also develop audio and perceptual skills. The teaching of critical thinking at least at the lower levels is also within its capability. An example of this would be "trouble

shooting" defective equipment based on an evaluation of the symptoms--a skill which would be transferable by a talented programmer.

The potential for decentralization of training under such a system is great. Formal classroom training would be minimized. Through the use of remote student consoles which could trigger, through micro-wave transmission, large computers containing extensive libraries with rapid access capability, better and more economical training could be conducted.

Summary

The information contained within this chapter shows that the Navy ADP program has definite time stages outlined for the accomplishment of its objectives. We are now embarking upon the final planned stage (1965-1970), and it is expected that the objectives outlined in Chapter II will be met by the completion of this stage.

As was pointed out, a major problem area is the training of management personnel to fully utilize the potential of ADP equipment. When management "catches up" with the equipment available for its use, the fulfillment of the objectives of the program will follow close behind. Whether this actually takes place by 1970 still remains to be seen.

The brief description of four general areas of computer use, as presented, shows that Automatic Data Processing allows a

change in methodology and thinking from concepts of the past. This review also points out areas that Navy management can expect computer application in the future for the gaining of increased effectiveness.

CHAPTER IV

SUMMARY AND CONCLUSIONS

In starting this paper it was intended to answer the following questions. Does the Naval service have a formal ADP program? What are the Navy goals, both short and long range as regards management's use of ADP equipment? What problems exist within the Naval service because of ADP that concern management? What are some of the implications for the future concerning management because of Automatic Data Processing?

Research discloses that a formal organization does exist within the Navy Department for the control of ADP matters. The history and growth of the ADP organization, both as regards management and equipment usage, have been very rapid. The formal ADP program within the Naval establishment places definite responsibilities for the meeting of program objectives. The objectives, both long and short range are clearly defined. The ultimate objective is an optimal information service to Navy and Marine Corps management of resources. To reach this ultimate objective the road is paved with short range and long range individual goals. Such goals as complete integration, information selectivity, maximum use of management by exception, and maximum use

of management sciences are all expected to be achieved.

These concepts all have an effect on management's methodology and ability to make more informed decisions. The attainment of the objectives and goals which ADP will help make possible is planned to be realized by 1970.

The main problem the Naval service is experiencing is that of getting all levels of management to the position whereby managers are fully capable of utilizing the equipment available. The problem is recognized and various means of educating management are currently in progress. The "Defense Computer Institute" is one means. Use of the institute and by exposing students in the other curricula sponsored by the Navy to ADP uses and ramifications should in time solve this particular problem.

Areas such as Naval Personnel Management, Cost Information Systems, Military Pay and Allowances, and Training of Naval Personnel are discussed. These areas are examples of where ADP and computers are currently being used to achieve increased effectiveness, and also areas in which there are applications which are possible but have not yet been adopted.

In answering the above questions the conclusions which can be formed are that Naval management functions, concepts and techniques are undergoing change and can expect further changes in the years to come as a result of the use of automatic data processing equipment. Training is presently being conducted to

prepare management for this changing era. ADP equipment is a vital tool for management's use to help in the decision making process, and the Navy is working diligently to see to it that maximum use is made of equipment that is presently available.

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